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Public Sector Investment in Energy: Budgetary Constraints and Trade-Offs in Pakistan

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Public sector investment in energy

Budgetary constraints and trade offs in Pakistan

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The generation, transmission and distribution of electrical power is essential for the development of an economy. Potential bottlenecks in the electricity sector can have a far reaching impact on overall economic growth. In many developing countries the public sector is the most active agent in the provision of vital energy services. This article examines Pakistan's experience with public sector investment in energy. A model of government budgetary allocations to energy is developed. In applying this model to Pakistan, the paper analyses the impact of fiscal pressures, unanticipated government expenditure, and competing priorities which have constrained the government's investment programme. The main conclusion reached in the paper is that Pakistani authorities must continue to actively encourage private sector power projects. Otherwise, the country is unlikely to be able to sustain its growth given an increasingly severe energy shortage.

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The generation, transmission and distribution of electrical power has a unique place as part of the basic physical infrastructure needed during the course of developing of an economy. It provides an essential input in an industrial economy. The backward and forward linkages with the rest of the industrial economy are, perhaps, the strongest, so that potential bottlenecks in the electricity sector can have a far reaching impact on overall economic growth.[1]

Pakistan's energy needs have grown rapidly, at around 8% annually. Shortages of electricity have seriously hurt the country's industrial enterprises with one recent estimate placing losses at around $1 billion annually in lost gross national product (GNP).[2] Understandably, the energy sector is a matter of vital importance in the government's economic strategy.

Since the mid-1970s the public sector has provided nearly all of the funds for energy development. Consequently, it is of some interest to examine the factors affecting and perhaps constraining government investment in this sector. What factors have influenced the government to invest in energy? What budgetary pressures have prevented the public sector from expanding energy investment even more rapidly? What other areas of public expenditure compete with energy for funding?

Overview

Pakistan's per capita consumption of commercial energy used to be very low, but it has been rising rapidly in the last few years (see Tables 1 and 2), and by 1988 it was the highest in the South Asian region (Table 1). At the present time oil accounts for around 40% of commercial energy consumed and gas for 35%. It is estimated that in 1987–88 31.8% of total energy requirements were met from such non-commercial sources as firewood, cow dung and charcoal.[3] Population growth continually increases pressure on these sources. Consumption of electricity increased 11.7% per year in the 1980–88 period, double the rate of

[1]Economic and Social Commission for Asia and the Pacific, *Economic and Social Survey of Asia and the Pacific, 1990*, United Nations, New York, 1991, p 131.
[2]Anthony Hyman, 'Pakistan', in *The Middle East Review, 1991/92*, World Information, Essex, 1991, p 109.
[3]Economist Intelligence Unit, *Pakistan, Afghanistan: Country Profile, 1990–91*, Economist Intelligence Unit, London, 1991, p 29.

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Table 1. Consumption of electricity, 1970–88: Pakistan and selected Asian countries.

Country	Million kilowatt hours 1970	1980	1988	Annual percent increase 1970–80	1970–88	1980–88	Consumption per capita 1988
South Asia							
Pakistan	8 727	15 277	36 940	5.8	8.3	11.7	350.5
India	61 212	119 190	238 530	6.9	7.8	9.1	299.4
Afghanistan	396	970	1 109	9.4	5.9	1.7	71.6
Sri Lanka	816	1 668	2 799	7.4	7.1	6.7	168.6
Burma	600	1 433	2 272	9.1	7.7	5.9	57.8
Bangladesh	1 404	2 653	6 866	6.6	9.2	12.6	64.4
Nepal	76	257	641	13.0	12.6	12.1	35.6
East Asia							
Thailand	4 507	15 743	34 374	13.3	11.9	10.3	629.6
Indonesia	2 300	7 140	37 010	12.0	16.7	22.8	211.2
South Korea	9 597	39 979	85 462	15.3	12.9	10.0	2 034.8
Malaysia	3 543	8 974	19 287	9.7	9.9	10.0	1 141.2
Hong Kong	5 097	12 341	24 068	9.2	9.0	8.7	4 222.5
Singapore	2 205	6 940	13 018	12.1	10.4	8.2	4 821.5
Philippines	8 666	18 032	24 538	7.6	6.0	3.9	418.0

Source: Economic and Social Commission for Asia and the Pacific, *Economic and Social Survey of Asia and the Pacific, 1990*, United Nations, New York, 1991, p 133. Per capita consumption is in kilowatt hours.

Table 2. Pakistan: energy indicators, 1973–87.[a]

Indicator	1973	1980	1987	Growth rate (%) 1973–87	1973–80	1980–87
Primary energy consumption (thousand toe)	7703	12638	21433	7.6	7.3	7.8
Final energy consumption (thousand toe)	5603	8923	14933	7.3	6.9	7.6
Energy intensity (toe)	0.473	0.534	0.569	1.3	1.7	0.9
Oil intensity (toe)	0.195	0.196	0.222	0.9	0.0	1.8
National energy conversion losses (%)	27.3	29.4	30.0	0.7	1.1	0.3
Electricity share in primary energy (%)	28.0	30.8	34.3	1.5	1.4	1.5
Net energy import dependence (%)	36.2	33.6	33.6	−0.5	−1.1	0.0
Net oil import dependency (%)	35.9	33.1	30.6	−1.1	−1.2	−1.1

Source: Energy Planning Unit, Industry and Development Banks Department, *Energy Indicators of Developing Member Countries of ADB*, Asian Development Bank, Manila, May 1989, p 381.

[a] Toe = tonne of oil equivalent; energy intensity is measured as primary energy consumption in toe divided by US$1000 real gross domestic product (GDP) at 1980 constant prices; oil intensity is measured as oil consumption in toe divided by US$1000 real GDP.

increase in the 1970s. As Table 2 indicates, total consumption of all forms of energy increased at an annual average rate of 7.6% in the 1980–87 period (up from 6.9% for the 1973–80 period).

Pakistan was 79% self-sufficient in commercial energy in 1986. The balance was mainly met by imports of petroleum and petroleum products. At present the country's major domestic resource is natural gas, followed by oil and hydroelectric power. After India, Pakistan is clearly the largest producer of electricity in South Asia (see Table 3). Indeed, its total production of electricity rivals that of Indonesia, a South-east Asian country with a much larger population and substantial oil reserves. As Table 3 indicates, there has been a general shift from hydro to thermal sources in Pakistan with the net result that imports of petroleum and petroleum products have become a heavy burden on the balance of payments, accounting in the early 1980s for about 30% of all imports by value.[4] While the overall oil intensity has increased, nevertheless the net oil import dependency has fallen by 1.1% per year in the 1980s (see Table 2).

Major issues

If Pakistan is suffering from serious shortages of energy it is largely due to insufficient development of domestic resources in the face of rapidly increasing demand. Ultimately the country's energy problems are related to low levels of investment which have been financed, nearly

[4] *Ibid.*

Table 3. Electricity production by type 1980 and 1988: Pakistan and selected Asian countries (million kilowatt hours).

Country	1980 production Total	Thermal	Hydro	1988 production Total	Thermal	Hydro
South Asia						
Pakistan	15 277	6 558	8 719	36 940	20 185	16 755
India	119 226	72 679	46 548	237 800	185 856	51 944
Afghanistan	970	300	670	1 109	357	752
Sri Lanka	1 668	189	1 479	2 799	202	2 597
Burma	1 433	559	874	2 272	1 151	1 121
Bangladesh	2 653	2 070	853	6 866	6 191	675
Nepal	221	38	183	589	26	563
East Asia						
Thailand	14 985	11 285	3 700	33 964	30 185	3 779
Indonesia	7 140	4 540	2 600	37 010	29 000	7 800
South Korea	39 979	37 995	1 984	85 462	81 896	3 566
Malaysia	8 974	7 719	1 255	19 287	13 684	5 603
Hong Kong	12 649	12 649	0	25 508	25 508	0
Singapore	6 940	6 940	0	13 018	13 018	0
Philippines	18 032	14 478	3 554	24 538	18 260	6 278

	1980 ratio (%) Thermal	Hydro	1988 ratio (%) Thermal	Hydro
South Asia				
Pakistan	43	57	55	45
India	61	39	78	22
Afghanistan	31	69	32	68
Sri Lanka	11	89	7	93
Burma	39	61	51	49
Bangladesh	78	22	90	10
Nepal	17	83	4	96
East Asia				
Thailand	75	25	89	11
Indonesia	64	36	78	21
South Korea	95	5	96	4
Malaysia	86	14	71	29
Hong Kong	100	0	100	0
Singapore	100	0	100	0
Philippines	80	20	74	26

Source: Economic and Social Commission for Asia and the Pacific, *Economic and Scial Survey of Asia and the Pacific, 1990*, United Nations, New York, 1991.

exclusively, by the federal government. In fact, energy sector investments (mostly by the Water and Power Development Authority (WAPDA)) accounted for nearly one-third of the public investment programme in 1990 (see Table 4). In 1989 energy accounted for 12.5% of all government expenditure.

Table 4. Pakistan: capital formation in energy, 1970–90.

	Energy share in in capital formation (million rupees) Total	Public	Private	Shares of total government expenditure (%) Energy	Consumption	Defence
1970	3.9	4.7	3.1	2.0	61.4	37.7
1971	9.7	16.4	3.1	7.2	66.0	43.3
1972	7.1	12.5	2.0	4.7	73.8	46.4
1973	6.5	9.8	3.0	3.4	69.4	42.2
1974	6.7	10.4	–	4.9	58.8	40.8
1975	14.9	22.0	–	12.4	61.2	38.5
1976	14.0	19.6	–	14.2	67.8	36.2
1977	9.5	13.5	–	10.3	68.0	36.8
1978	9.6	13.7	–	9.0	62.1	33.3
1979	9.6	13.8	–	8.3	56.1	33.4
1980	6.0	8.8	–	5.7	57.3	35.5
1981	7.1	12.9	–	6.3	53.0	33.2
1982	7.2	12.5	–	7.1	60.6	40.9
1983	10.0	17.7	–	8.8	59.0	38.2
1984	8.9	16.2	–	7.4	61.4	37.1
1985	10.2	18.9	–	8.5	61.0	37.5
1986	9.5	17.6	–	7.0	54.7	32.4
1987	11.7	21.0	–	9.1	60.6	34.4
1988	11.9	22.2	–	8.3	58.2	30.4
1989	16.8	32.5	–	12.5	65.0	30.3
1990	16.0	32.8	–	na	na	na

Sources: Data for 1970–71 from work sheet compiled by Regina Bendokat, World Bank; data for 1972–80 from *Pakistan: Review of the Sixth Five Year Plan*, World Bank, Washington, 1983; data for 1981–90 from *Pakistan: Current Economic Situation and Prospects*, Report No. 9283-PAK, World Bank, Washington DC, 22 March 1991. Total government expenditures 1970–89 from *International Financial Statistics, 1990*, International Monetary Fund, Washington, 1990.

The small public investment programme is both insufficient and unsustainable because of conflicting demands from other sectors. For example, by 1990 defence claimed over 30% of all government expenditure. Therefore, in addition to higher domestic resource mobilization by the public sector (and by the energy sector companies), increased private sector investment in energy is essential.[5]

The collapse of private investment in energy coincides with the general expansion of the public sector in economic activity following the civil war in the early 1970s. Immediately after Bangladesh separated from Pakistan, the Pakistani government developed an economic strategy relying more on government involvement in the economy.[6]

From 1971–73 the major emphasis was on the introduction of structural reforms, a revival of economic activity and a restructuring of the economy after its virtual collapse following the civil war in what was then East Pakistan and the loss of the East Pakistan market.

After the initial rehabilitation of the economy, the long-term strategy had two main objectives.[7] The first objective was to transform the industrial sector from its consumer goods bias towards the setting up of basic industries mainly through an expansion of the public sector. The second objective was to invest substantially in infrastructure – especially in the development of water, power, gas and communications.

Many of the problems faced by the energy sector today can be traced back to the manner in which this strategy was implemented. Since the increase in public investment and social services could not be met through public sector savings, they were to be financed through large amounts of foreign aid and deficit financing. Apparently the government felt itself committed to bringing about structural changes so as to make the economy self-reliant. The effect of the ensuing economic squeeze was to firm rather than mitigate the government's resolve to make these changes. As noted in an official document: 'The only way out for the economy from the terrible squeeze experienced during the year was to move towards self reliance in food, fertilizer, energy and basic industries.'[8]

The government therefore took considerable pride in the fact that it was going through with its heavy public investment programme against very heavy odds, resorting to deficit financing to generate funds for its public investment.[9] Shortages of resources to fund energy projects adequately have continued to this day. In addition, the energy sector has found that it must compete with other infrastructure categories for the small percentage of the budget allocated to development. The precise nature of these relationships is identified in the following section.

A model of budgetary allocations to energy

While the government is committed to providing additional funds to energy development, other areas such as defence have priority for funding. In addition the government has, from time to time, attempted to constrain the growth of fiscal deficits.

As a preliminary step in developing a model of government allocation to energy it would be reasonable to assume that the authorities undertake investment to bridge the gap between the actual stock of energy capital and the perceived optimal level of assets devoted to energy production. The process takes place as follows:

[5]The World Bank, *Pakistan: Current Economic Situation and Prospects*, Report No. 9283-PAK, The World Bank, Washington, DC, 22 March 1991, p 36.
[6]Viqar Ahmed and Rashid Amjad, *The Management of Pakistan's Economy: 1947–82*, Oxford University Press, Karachi, 1984, p 96.
[7]*Ibid.*
[8]Planning Commission, *Annual Plan 1975–76*, Government of Pakistan, Islamabad, 1976.
[9]*Op cit*, Ref 6, p 96.

$$DIGEN_t = b(IGEN^*_t - IGEN_{t-1}) \quad (1)$$

where $IGEN^*$ is the desired level of gross public investment in the energy sector. $IGEN$ is the actual level of gross energy investment; b is the coefficient of adjustment with b greater than or equal to 0 (and less than or equal to 1); and D is a difference operator in the steady state. The desired rate of gross energy investment can be related to the desired stock of energy capital EK^* in the following way:

$$IGEN^*_t = [(1-(1-z)L)EK^*_t] \quad (2)$$

where z is the rate of depreciation and L is a lag operator: $LEK_t = EK_{t-1}$.

In the long-run representation of the simple accelerator model, the desired stock of capital can be assumed to be proportional to lagged output, YR_{t-1}:

$$EK^*_t = aYR_{t-1} \quad (3)$$

That is, the authorities expand the stock of capital in the energy sector to satisfy the demand generated by an expanding economy. Combining Equations (1)–(3) and solving for $IGEN_t$ yields the basic dynamic accelerator function:

$$IGEN_t = [1-(1-z)L]\, baY_{t-1} + [(1-b)IGEN_{t-1}] \quad (4)$$

As for the role of other factors in the rate of capital formation in the energy sector, we hypothesize that the response of gross private investment to the gap between desired and actual investment, as measured by b in Equation (1), is not a fixed parameter but rather varies systematically with economic factors that influence the ability of the authorities to achieve the desired level of investment.

We assume the ability of the authorities to respond depends on the priority ranking given energy development. This ranking can in turn be revealed by the manner in which the government responds to unanticipated budgetary shifts and willingness to fund other ministries. Here, unanticipated deficits are defined as the difference between the actual deficit and that expected or forecast.[10]

Finally, we assume that the government responds to unanticipated deficits differently depending on when they occur in the budgetary cycle. Increased unanticipated deficits in the previous fiscal year are likely to cause cut backs in funding in the current fiscal year. On the one hand, the impact of unanticipated deficits in the current fiscal year can either increase or decrease energy funding depending on the priority given that type expenditure. That is, if energy has a high budgetary priority unanticipated deficits are likely to reflect increased spending to sustain the level of funding to that sector. On the other hand, if energy has a relatively low priority, unanticipated deficits will result in cutbacks in funding:

$$b_t = b_0 + \frac{1}{[IGEN^*_t - IGEN_{t-1}]}[b1\, GDEFU_{t-1} + b2\, GDEFU_t] \quad (5)$$

where $GDEFU_{t-1}$ is the value of the real unanticipated public sector deficit in period $t-1$, and $GDEFU_t$ represents the unanticipated government deficit in the current period. Equation (5) states that the response of public sector investment depends on the magnitude of the two factors measured in relative terms with respect to the size of discrepancy

[10]The forecast or anticipated deficit is defined as that predicted by the equation obtained through regressing the current year's deficit on that of the previous year.

between desired and actual investment $[IGEN^*_t - IGEN_{t-1}]$.

Substituting Equation (5) into Equation (1) yields:

$$IGEN_t = b_0[IGEN^*_t - IGEN_{t-1}] + b1\ GDEFU_{t-1} + b2\ GDEFU_t \quad (6)$$

Since from Equations (2) and (3) we show that

$$IGEN^*_t = b_0a[YR_{t-1} - YR_{t-2}] + b1\ GDEFU_{t-1} + b2\ GDEFU_t + (1-b0)\ IGEN_{t-1}$$

we can new derive a dynamic reduced form equation for gross private investment:

$$IGEN_t = b_0a[YR_{t-1}) - (1-c)YR_{t-2}] + b1\ GDEFU_{t-1} + b2\ GDEFU_t + (1-b_0)\ IGEN_{t-1} \quad (7)$$

The effects of economic growth and fiscal developments on government investment in energy can be directly obtained from the estimates of $b1$ and $b2$.

For completeness a final term was added to the regression equation – that for unanticipated changes in allocations to other (non-energy) budgetary categories.[11] A negative sign on this term would indicate that it receives a higher priority in the allocation process than that afforded energy.

The data used in the estimations were derived from figures in World Bank, *Pakistan: Current Economic Situation and Prospects* – Report No. 9283-PAK (22 March 1991); and, World Bank, *Pakistan: Review of the Sixth Five Year Plan (1983)*. Gross domestic product and the GDP price deflator are from various issues of the International Monetary Fund, *International Financial Statistics Yearbook*. All variables were deflated by the GDP deflator and are in constant 1985 prices.

Empirical results

The regression results are presented in Table 5. For convenience, the following symbols are used in the table: $DY_{t-1} = YR(t-1) - YR(t-2)$. $IGEN_t$ is public sector investment in energy; $IGEN_{t-1}$ is public sector investment in energy in the previous year; $GDEFU_t$ is the unanticipated public sector budgetary deficit; and $GDEFU_{t-1}$ is the unanticipated public sector budgetary deficit in the current year.

Several different types of unanticipated government expenditures were examined on the margin ie after the effects of economic growth and the deficits had been taken into account:

- military expenditures (*MILXU*);
- non-military expenditures (*NMILXU*);
- total government investment (*IGTU*);
- public enterpriese (*IGEU*);
- post, office, telephone, telegraph (*IGPOU*);
- general government investment (*IGGU*);
- rural works (*IGRWU*);
- Indus Basin investment (*IGIBU*);
- large-scale industry investment (*IGLIU*); and,
- small-scale industry investment (*IGSIU*)

The analysis in Table 5 confirmed the importance of public infrastructure in stimulating private sector investment in the transport and

[11] Unanticipated changes in expenditures are estimated in a manner similar to that of deficits. That is, unanticipated changes in allocations are defined as the difference between actual (final) allocations and those that were anticipated at the beginning of the fiscal year. In turn, anticipated allocations were estimated from the equation derived by regressing each category's allocation on that received in the previous year.

Table 5. Factors affecting government investment in energy in Pakistan: long-run adjustment to unanticipated budgetary shocks, 1972–90 (standardized coefficients).[a]

Budgetary deficit component

$$IGEN_t = \underset{(2.45)^{**}}{0.18\, IGEN_{t-1}} + \underset{(5.45)^{***}}{0.58\, DY_{t-1}} + \underset{(2.99)^{**}}{0.24\, GDEFU_t} - \underset{(-3.02)^{**}}{0.26\, GDEFU_{t-1}}$$

r^2 (adj) = 0.913 Durbin's h = −0.86 F = 37.76

Unexpected military expenditure (MILXU)

$$IGEN_t = \underset{(3.41)^{***}}{0.34\, IGEN_{t-1}} + \underset{(5.22)^{***}}{0.46\, DY_{t-1}} + \underset{(3.13)^{**}}{0.19\, GDEFU_t} - \underset{(-2.51)^{**}}{0.20\, GDEFU_{t-1}} - \underset{(-3.93)^{***}}{0.23\, MILXU_t}$$

r^2 (adj) = 0.947 Durbin's h = 0.26 F = 51.23

Unexpected non-military expenditure (NMILXU)

$$IGEN_t = \underset{(1.11)}{0.14\, IGEN_{t-1}} + \underset{(5.13)^{***}}{0.65\, DY_{t-1}} + \underset{(2.14)^{*}}{0.44\, GDEFU_t} - \underset{(-2.09)^{*}}{0.19\, GDEFU_{t-1}} + \underset{(0.89)}{0.20\, NMILXU_t}$$

r^2 (adj) = 0.907 Durbin's h = −1.32 F = 28.41

Unexpected government investment (IGTU)

$$IGEN_t = \underset{(0.25)}{0.05\, IGEN_{t-1}} + \underset{(2.68)^{**}}{0.46\, DY_{t-1}} + \underset{(2.83)^{**}}{0.25\, GDEFU_t} - \underset{(-2.40)^{**}}{0.21\, GDEFU_{t-1}} + \underset{(0.80)}{0.22\, IGTU_t}$$

r^2 (adj) = 0.940 Durbin's h = −1.41 F = 28.41

Unexpected investment in public enterprise (IGEU)

$$IGEN_t = \underset{(2.38)^{**}}{0.28\, IGEN_{t-1}} + \underset{(5.56)^{***}}{0.53\, DY_{t-1}} + \underset{(3.52)^{***}}{0.25\, GDEFU_t} - \underset{(-3.67)^{***}}{0.28\, GDEFU_{t-1}} - \underset{(-2.08)^{*}}{0.13\, IGEU_t}$$

r^2 (adj) = 0.958 Durbin's h = −1.34 F = 40.88

Unexpected investment in the post office, telephone, telegraph (IGPOU)

$$IGEN_t = \underset{(2.87)^{**}}{0.26\, IGEN_{t-1}} + \underset{(6.93)^{***}}{0.52\, DY_{t-1}} + \underset{(2.65)^{**}}{0.17\, GDEFU_t} - \underset{(-4.93)^{**}}{0.32\, GDEFU_{t-1}} - \underset{(-3.17)^{**}}{0.12\, IGPOU_t}$$

r^2 (adj) = 0.952 Durbin's h = −1.07 F = 56.40

Unexpected general government investment (IGGU)

$$IGEN_t = \underset{(1.11)}{0.15\, IGEN_{t-1}} + \underset{(4.76)^{***}}{0.61\, DY_{t-1}} + \underset{(2.75)^{**}}{0.23\, GDEFU_t} - \underset{(-2.89)^{**}}{0.26\, GDEFU_{t-1}} - \underset{(-0.46)}{0.04\, IGGU_t}$$

r^2 (adj) = 0.906 Durbin's h = −0.87 F = 27.84

Unexpected rural works investment (IFRWU)

$$IGEN_t = \underset{(0.47)}{0.07\, IGEN_{t-1}} + \underset{(4.15)^{***}}{0.66\, DY_{t-1}} + \underset{(0.35)^{**}}{0.04\, GDEFU_t} - \underset{(-2.31)^{**}}{0.27\, GDEFU_{t-1}} - \underset{(-2.94)^{**}}{0.30\, IGRWU_t}$$

r^2 (adj) = 0.901 Durbin's h = 0.03 F = 26.60

Unexpected Indus Basin investment (IGIBU)

$$IGEN_t = \underset{(1.39)}{0.18\, IGEN_{t-1}} + \underset{(4.86)^{***}}{0.57\, DY_{t-1}} + \underset{(2.81)^{**}}{0.24\, GDEFU_t} - \underset{(-2.88)^{**}}{0.26\, GDEFU_{t-1}} - \underset{(-0.14)}{0.01\, IGIBU_t}$$

r^2 (adj) = 0.904 Durbin's h = −0.95 F = 27.24

Unexpected large-scale industry investment (IGLIU)

$$IGEN_t = \underset{(2.96)^{**}}{0.32\, IGEN_{t-1}} + \underset{(5.54)^{***}}{0.59\, DY_{t-1}} + \underset{(2.09)^{*}}{0.15\, GDEFU_t} - \underset{(-3.49)^{***}}{0.28\, GDEFU_{t-1}} + \underset{(3.27)^{***}}{0.25\, IGLIU_t}$$

r^2 (adj) = 0.942 Durbin's h = −0.30 F = 46.27

Unexpected small-scale industry investment (IGSIU)

$$IGEN_t = \underset{(1.63)}{0.19\, IGEN_{t-1}} + \underset{(4.94)^{***}}{0.52\, DY_{t-1}} + \underset{(3.08)^{**}}{0.23\, GDEFU_t} - \underset{(-3.50)^{***}}{0.29\, GDEFU_{t-1}} + \underset{(1.61)}{0.11\, IGSIU_t}$$

r^2 (adj) = 0.925 Durbin's h = −1.11 F = 35.41

[a] Equations estimated with *SORITEC Statistical Analysis System Version 6.5*, Sorites group, Springfield, VA, 1990. Estimation method is ordinary least squares with a Cochrane–Orcutt iterative autocorrelation procedure to correct for first and second degree autocorrelation in the disturbances. r^2 = coefficient for determination from the differenced model; Durbin's h = Durbin's h statistic for equations with lagged variables; F = F statistic; ( ) = t statistic of significance; *** significant at the 99th level of confidence; ** significant at the 95th level of confidence; * significant at the 90th level of confidence; t = current time period; $t-1$ = previous time period; D = difference from $t-1$ to t. All variables deflated with the GDP deflator and are in 1985 prices.

communications sector. Several points are worth noting. First, the statistical significance of the lagged investment term indicates that the public sector's capital formation in energy follows the distributed lag relationship assumed above. That is, investment by the government in energy type projects adjusts over time to bridge the gap between the actual level of capital stock and that deemed optimal by the authorities.

Second, it should be noted, however, that this relationship is not particularly strong as indicated by the relatively small regression coefficient, together with the marginal statistical significance in several of the regressions.

Third, the lagged unanticipated deficit ($GDEFU_{t-1}$) has the expected sign (deficits are defined as expenditures minus revenues) in that unanticipated shortfalls in the previous fiscal year constrain energy investments during the current budgetary period.

Fourth, as an alternative, the government might be willing to incur larger deficits than perhaps anticipated at the beginning of the fiscal year in order to maintain funding for the energy sector (as evidenced by the positive sign, together with the relatively large coefficient on the $GDEFU_t$ term).

Fifth, given the fiscal environment described above, the government appears inclined to allocate funds to defence rather than to energy. Unanticipated increases in defence expenditures depress the allocations to energy while non-military expenditures do not have this effect.

Sixth, the government also appears to favour public enterprises over energy. These organizations consist largely of the railways and the post office, telephone and telegraph. Separate analysis of the components of public enterprises indicated that this effect was largely confined to the post office, telephone and telegraph. The railways were found insignificant when examined separately.

Seventh, when funds were scarce, the government also favoured rural work programmes over energy. However, there was no relationship between energy investment and funds allocated to Indus Basin projects.

Finally, on the other hand, the authorities treated their investment in public large-scale enterprises as complementary to energy investment ie they expanded energy investment to coincide with unanticipated increases in funds allocated to the industrial sector. However, a much weaker relationship exists between energy investment and that of the government's capital formation in small-scale public manufacturing firms.

In sum, government funding of energy development in Pakistan is a mixed picture. On the one hand, the authorities appear willing to risk the consequences of larger budgetary deficits to fund allocations to that sector. On the other hand, energy has not been particularly successful in competing for funds. Defence expenditures, in particular, have a much higher budgetary priority over several other major expenditure categories.

Conclusions

Given the government's budgetary constraints and the pressures (and willingness) to fund non-energy programmes at the expense of energy development, the private sector should be encouraged to play a major role in the provision of energy services. In this regard the Seventh Plan (1988–93) provides an excellent departure from past policy. An important feature of the plan is the specific encouragement given to private sector investment in the energy sector. In fact the plan expects the contribution of the private sector in power system development to be over 200 MW.[12]

In terms of implementation, the government intends to provide incentives, including designating areas for private sector power projects which have been identified, defining conditions for purchase of power by the public power companies, assigning a major portion of several coal fields for private sector generation and designating selected dormant gas fields for private sector power development. All of these measures should relieve some of the pressure on the government to provide for the country's rapidly expanding energy needs. Without this change in policy, it is hard to see how the economy would be able to sustain its growth in the wake of an increasingly severe energy shortage.

[12]Planning Commission, *Seventh Five Year Plan: 1988–93 and Perspective Plan, 1988–2003*, Government of Pakistan, Islamabad, 1988, p 196.